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[Management Brief]

Effect of Block Net Use and Time of Sampling on Backpack Electrofishing Catches in Three Kansas Reservoirs

CASEY W. SCHOENEBECK,*[1] TIMOTHY R. STRAKOSH, and CHRISTOPHER S. GUY[2]

U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit,[3]
205 Leasure Hall, Kansas State University, Manhattan, Kansas 66506, USA

Abstract.—Using backpack electrofishing in three Kansas reservoirs, we investigated the need for block nets when estimating density (fish/ha) and species diversity and determined whether time of sampling affected catch rates (fish/h) of age-0 largemouth bass *Micropterus salmoides* and age-0 *Lepomis* spp. and species diversity. Block nets were used to enclose or buoys were used to mark the boundaries of 149 m^2 of reservoir surface area. Species richness, diversity, and density of age-0 largemouth bass and *Lepomis* spp. did not differ significantly between areas enclosed with block nets and areas marked with buoys, but species richness, diversity, and catch rates differed significantly between day and night sampling. Age-0 largemouth bass and *Lepomis* spp. catch rates, species richness, and species diversity were all significantly higher during night sampling. Our results indicate that use of block nets may not be necessary to estimate age-0 largemouth bass and *Lepomis* spp. densities, species richness, or diversity in reservoir littoral areas. We recommend night sampling because of significantly higher catch rates and better representation of the littoral fish assemblage.

Backpack electrofishing gear is commonly used for stream sampling (Onorato et al. 1998; Pipas and Bulow 1998; Horton et al. 2000) because of its ability to sample complex structure, aquatic vegetation, and depths less than 0.5 m (Dauble and Gray 1980; Vadas and Orth 1993). Recently, backpack electrofishing has been shown to effectively represent the littoral fish community (Fago 1998; Drake and Pereira 2002), including the capture of small fishes (Tripe 2000; Vaux et al. 2000). However, how (necessity of block nets) and when (time of day) to best use backpack electrofishing in littoral zones is unresolved.

Historically, electrofishing studies of largemouth bass *Micropterus salmoides* and *Lepomis* spp. have used boom-mounted electrodes to target harvestable-sized fish (Gilliland 1987; Maceina et al. 1995; Dumont and Dennis 1997; McInerny and Cross 2000). Past studies have investigated differences between day and night sampling and have found varying results. Catchability of harvestable largemouth bass (≥251 mm total length) in Lake Guntersville, Alabama, was not significantly different between day and night (Maceina et al. 1995). Catch rates (fish/h) of largemouth bass were higher at night than day in two Oklahoma reservoirs, but day boat electrofishing was more efficient for sampling age-0 largemouth bass (Gilliland 1987). Similarly, Dumont and Dennis (1997) found that night electrofishing in the fall produced higher catch rates of largemouth bass and more precise population estimates than day sampling. They also found bluegills *L. macrochirus* less than 76 mm were collected in the littoral zone regardless of time of day in 16 Texas reservoirs, but catch rates of bluegills were significantly higher at night than during the day. Malvestuto and Sonski (1990) reported that catch rates of bluegills in West Point Reservoir, Georgia, were higher at night. Therefore, when sampling for age-0 largemouth bass and age-0 *Lepomis* spp. in the littoral zone, the best time of day to use backpack electrofishing remains unresolved.

Block nets have been used in numerous electrofishing studies to control fish movement to or from a sampling area when estimating density (Maceina et al. 1993; Maceina et al. 1995; Simonson and Lyons 1995; Tripe 2000). For example, block nets enclosing 0.11 ha and a boom-mounted electrofisher were used to conduct a catch-depletion estimate of age-0 largemouth bass in submergent aquatic vegetation in an Alabama reservoir (Maceina et al. 1993), and block nets

* Corresponding author: casey.schoenebeck@sdstate.edu

[1] Present address: South Dakota State University, Department of Wildlife and Fisheries Sciences, Box 2140B, Brookings, South Dakota 57007, USA.

[2] Present address: U.S. Geological Survey, Montana Cooperative Fishery Research Unit, Department of Ecology, Montana State University, Bozeman, Montana 59717, USA

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were also used in a large Kansas reservoir when backpack electrofishing for age-0 largemouth bass (Tripe 2000). However, the necessity of the block nets was not evaluated in either study. Simonson and Lyons (1995) found that species richness of nine Wisconsin streams did not differ with or without block net use because immigration and emigration were insignificant. The objectives of this study were to (1) evaluate the necessity of block nets when using backpack electrofishing to estimate density of age-0 largemouth bass and age-0 *Lepomis* spp., species richness, and species diversity in reservoirs, and (2) determine the best time of day to use backpack electrofishing when sampling for age-0 largemouth bass and *Lepomis* spp. in littoral zones of reservoirs.

Methods

The study was conducted on three reservoirs in eastern Kansas: Hillsdale Reservoir (1,854 ha), Melvern Reservoir (2,798 ha), and El Dorado Reservoir (3,400 ha). Hillsdale and Melvern reservoirs have similar fish communities but have lower species richness than El Dorado Reservoir. The main function of the reservoirs is flood control, but they also serve as water supplies and recreational areas.

We sampled six coves in each reservoir (18 total) during 9 July and 8 August in 2001 and 2002. Each cove contained four sampling sites: two day block nets, one day nonblock net (no block net used), and one night nonblock net. The day block-net sites were selected using random number tables and a numbered grid of sites within the cove. One day nonblock net site and one night nonblock net site per cove were located adjacent (paired) to one of the two block net sites (randomly determined). A paired sampling design was used to reduce variation between sampling sites and to avoid confounding factors (e.g., habitat and lake differences). Sampling at day sites was completed between 0800 and 2100 hours. Night sampling began 1 h after sunset and ended upon completion of one night electrofishing pass. Sites for the day versus night and blocked versus nonblocked comparisons were sampled on the same day to reduce weather-related variation in catchability (Dumont and Dennis 1997). Block-net versus nonblock-net comparisons were limited to just daylight samples.

Block nets (36.7 × 2.0 m) were composed of 3.2-mm bar mesh hung between the float line and lead-core line; we used these nets to create 149-m^2 enclosures (24.5 × 6.1 m) parallel to shore. The block net was carefully maneuvered into the study area before being secured to the bottom using poles in silty substrates or anchors on rocky substrates. Maximum water depths ranged from 0.1 m to 1.2 m. Nonblock net sites were created using buoys to mark the corners of the site.

Fish were sampled using a backpack electrofishing unit (model 15-C, Smith-Root, Vancouver, Washington; 200–300-V, pulsed DC). The unit was run at a frequency of 60 Hz and pulse width of 8 ms. The sampling crew consisted of one person electrofishing and one person dipnetting (3.2-mm bar mesh); the person electrofishing also helped with the dipnetting. All collected fish were identified to species, enumerated, and held until completion of all electrofishing runs. During nonblock net samples, fish were retained until all electrofishing runs were completed.

A minimum of three and a maximum of six runs were completed per enclosure, and we used Leslie depletion estimates with Ricker's *K* modification (Ricker 1975) to estimate density (fish/ha) of age-0 largemouth bass and age-0 *Lepomis* spp., for comparing block-net and nonblock net samples. Sample sites were electrofished using a zigzag pattern so the entire site was subjected to sampling. All tests were compared using paired *t*-tests to reduce variation between the two sites being directly compared ($\alpha = 0.05$).

One-run electrofishing catch-rate samples were compared between day nonblocked and night nonblocked sites. The first run of the day nonblocked sample was used to estimate catch rates for the day nonblocked sample (Simonson and Lyons 1995).

We compared species richness (number of species present) and species diversity of nonblocked day versus night samples and blocked versus nonblocked day samples. Species diversity was calculated with the following formula:

$$H' = \Sigma_{i=1}^{s} p_i[\log_2(p_i)],$$

where H' is the index of species diversity, s is the number of species, and p_i is the proportion of total fish belonging to the ith species (Krebs 1999).

Results

Abiotic variables were measured from the center of each sample site before sampling with a YSI Instruments model 85 (Yellow Springs Instruments, Yellow Springs, Ohio). Temperatures varied from 27.0°C to 34.5°C, turbidity varied from 10.9 to 70.7 nephelometric turbidity units (NTU), and conductivity varied from 253.3 to 381.0 μS/cm.

TABLE 1.—List of fish species sampled using backpack electrofishing in Hillsdale, Melvern, and El Dorado reservoirs in Kansas during 9 July–8 August in 2001 and 2002.

Species
Bigmouth buffalo *Ictiobus cyprinellus*
Black bullhead *Ameiurus melas*
Blackstripe topminnow *Fundulus notatus*
Bluegill *Lepomis macrochirus*
Bluntnose minnow *Pimephales notatus*
Brook silverside *Labidesthes sicculus*
Central stoneroller *Campostoma anomalum*
Channel catfish *Ictalurus punctatus*
Common carp *Cyprinus carpio*
Fathead minnow *Pimephales promelas*
Flathead catfish *Pylodictis olivaris*
Freshwater drum *Aplodinotus grunniens*
Gizzard shad *Dorosoma cepedianum*
Golden shiner *Notemigonus crysoleucas*
Green sunfish *Lepomis cyanellus*
Johnny darter *Etheostoma nigrum*
Largemouth bass *Micropterus salmoides*
Logperch *Percina caprodes*
Longear sunfish *Lepomis megalotis*
Longnose gar *Lepisosteus osseus*
Orangespotted sunfish *Lepomis humilis*
Orangethroat darter *Etheostoma spectabile*
Red shiner *Cyprinella lutrensis*
Redear sunfish *Lepomis microlophus*
River carpsucker *Carpiodes carpio*
Slenderhead darter *Percina phoxocephala*
Smallmouth bass *Micropterus dolomieu*
Suckermouth minnow *Phenacobius mirabilis*
Walleye *Sander vitreus*
Western mosquitofish *Gambusia affinis*
White bass *Morone chrysops*
White crappie *Pomoxis annularis*

The use of block nets to enclose sampling sites did not significantly affect density estimates of age-0 largemouth bass or age-0 *Lepomis* spp., species diversity, or species richness (Table 1; Figure 1). Density of age-0 largemouth bass was not significantly different between block-net and nonblock-net treatments ($t = -0.114$, df = 17, $P = 0.91$). Density of age-0 *Lepomis* spp. was also not significantly different between block-net and nonblock-net treatments ($t = -1.016$, df = 17, $P = 0.32$). Species diversity ($t = 1.167$, df = 17, $P = 0.06$) and species richness ($t = 2.015$, df = 17, $P = 0.26$) were not significantly different between block-net and nonblock-net treatments.

Time of sampling (day versus night) affected catch rates of age-0 largemouth bass and age-0 *Lepomis* spp., species diversity, and species richness (Table 1; Figure 2). Catch rates of age-0 largemouth bass were significantly lower during the day than at night ($t = -2.722$, df = 17, $P < 0.02$). Catch rates of age-0 *Lepomis* spp. were also significantly lower during the day than at night ($t =$

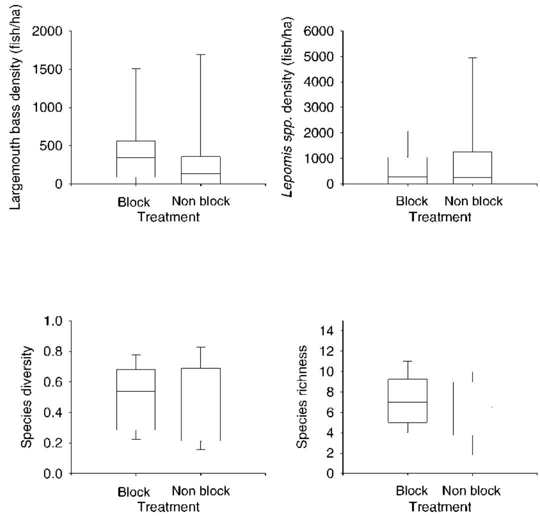

FIGURE 1.—Density of age-0 largemouth bass and age-0 *Lepomis* spp., species diversity, and species richness (H' as described by Krebs 1999) in block-net and nonblock-net enclosures sampled with backpack electrofishing in Hillsdale, Melvern, and El Dorado reservoirs in Kansas during 9 July and 8 August in 2001 and 2002. Boxes represent the 5th and 75th percentiles, and whiskers represent 95% confidence intervals.

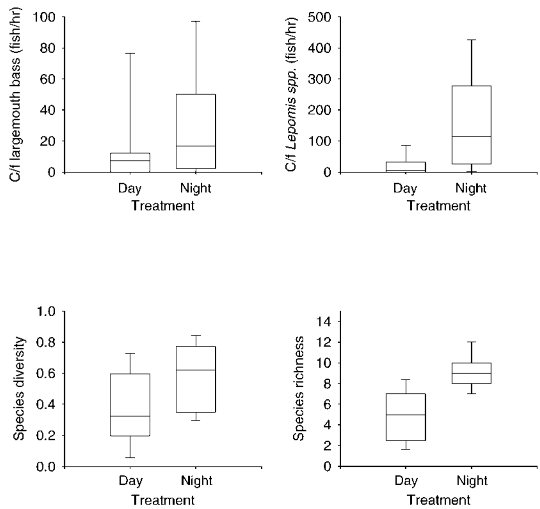

FIGURE 2.—Catch rates (C/f) of age-0 largemouth bass and age-0 *Lepomis* spp., species diversity, and species richness (H' as described by Krebs 1999) during day and night treatments sampled with backpack electrofishing in Hillsdale, Melvern, and El Dorado reservoirs in Kansas during 9 July and 8 August in 2001 and 2002. Boxes represent the 5th and 75th percentiles, and whiskers represent 95% confidence intervals.

-3.109, df $= 17$, $P < 0.01$). Similarly, species diversity ($t = -4.707$, df $= 17$, P < 0.001) and species richness ($t = -6.222$, df $= 17$, $P < 0.001$) were significantly lower during the day than at night.

Discussion

Our finding that block nets did not significantly affect density estimates of age-0 largemouth bass and age-0 *Lepomis* spp. is similar to results from studies on stream fishes. Block nets were not needed to estimate abundance of Wisconsin stream fishes when the sampled area was at least 35 times the wetted width of the stream (Simonson and Lyons 1995). Long sampling sites reduced the impacts of immigration and emigration (Simonson and Lyons 1995). Catch rates of fish were higher on the Columbia River when natural barriers restricted fish movement but decreased when more mobile species avoided capture by seeking deep water (Dauble and Gray 1980). Age-0 largemouth bass and *Lepomis* spp. are often associated with complex structures such as aquatic vegetation and fallen timber (Onorato et al. 1998). We found the effects of sampling-induced fish movement to be negligible. Age-0 centrarchids do not immigrate into or emigrate from the study area and block nets are unwarranted. We do agree with Simonson and Lyons (1995) that block nets should be considered when conducting depletion estimates to avoid violating the closed population assumption. Further study is needed to evaluate the use of block nets when conducting one-run catch rate surveys in lentic systems.

Our finding that species diversity and species richness were not significantly different between blocked and nonblocked sampling are corroborated by findings on stream fishes. Species richness was not significantly different between open and enclosed sampling on the upper Roanoke River (Vadas and Orth 1993). Similarly, block nets were not needed for sampling species richness and assemblage structure in Wisconsin streams (Simonson and Lyons 1995). Species richness when using a tow-barge electrofishing unit did not significantly differ between multiple-pass and single-pass nonblock-netted enclosures on the same Wisconsin streams (Simonson and Lyons 1995).

Our finding that night catch rates of age-0 largemouth bass and *Lepomis* spp. were significantly greater than day catch rates is contrary to other study findings on age-0 centrarchid catch rates using boom-mounted electrofishing units (Gilliland 1987; Dumont and Dennis 1997) but concurs with boat electrofishing studies focused on harvestable centrarchids (≥251 mm; Malvestuto and Sonski 1990; McInerny and Cross 2000; Pierce et al. 2001). Gilliland (1987) found that catch rates of largemouth bass in two Oklahoma reservoirs were significantly higher for all ages combined at night than during daylight, but age-0 catch rates were higher during daylight. In Texas reservoirs, catch rates of bluegills (<76 mm) were not significantly different between day and night (Dumont and Dennis 1997). In contrast, catch rates of bluegills were significantly greater during night than day in two Iowa lakes (Pierce et al. 2001). Pierce et al. (2001) also found age-0 bluegills accounted for the largest proportion of the night seining catch. Night boat electrofishing catch rates for largemouth bass (>200 mm) were significantly higher than day catch rates in Minnesota (McInerny and Cross 2000). Differences between our study and others mentioned could be due to biases in gear selectivity. Boom-mounted electrofishing units have been shown to underestimate age-0 largemouth bass by selecting for bass over 150 mm (Jackson and Noble 1995). Backpack electrofishing, on the other hand, allows operators to sample closer to the surface of the water and therefore see and capture smaller fish (Vaux et al. 2000). In addition, we suggest backpack electrofishing during night may enhance the dipnetter's vision by eliminating glare from the sun.

Our findings that species diversity and species richness were significantly greater during night electrofishing concur with results on two Iowa lakes (Pierce et al. 2001). Species diversity and species richness sampled via boat electrofishing were significantly greater during night than day (Pierce et al. 2001). Thus, we recommend night sampling for species occurrence data, biotic integrity indexes, and community evaluations.

Backpack electrofishing can be a useful tool for sampling age-0 largemouth bass and age-0 *Lepomis* spp. in reservoir littoral areas (Vaux et al. 2000). Our results indicate that use of a block net may not be necessary to estimate littoral area species diversity or species richness. To avoid violating the assumption of a closed population, block nets should be considered when estimating age-0 largemouth bass and *Lepomis* spp. densities. We recommend night sampling because of significantly higher catch rates and better representation of the littoral fish assemblage.

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